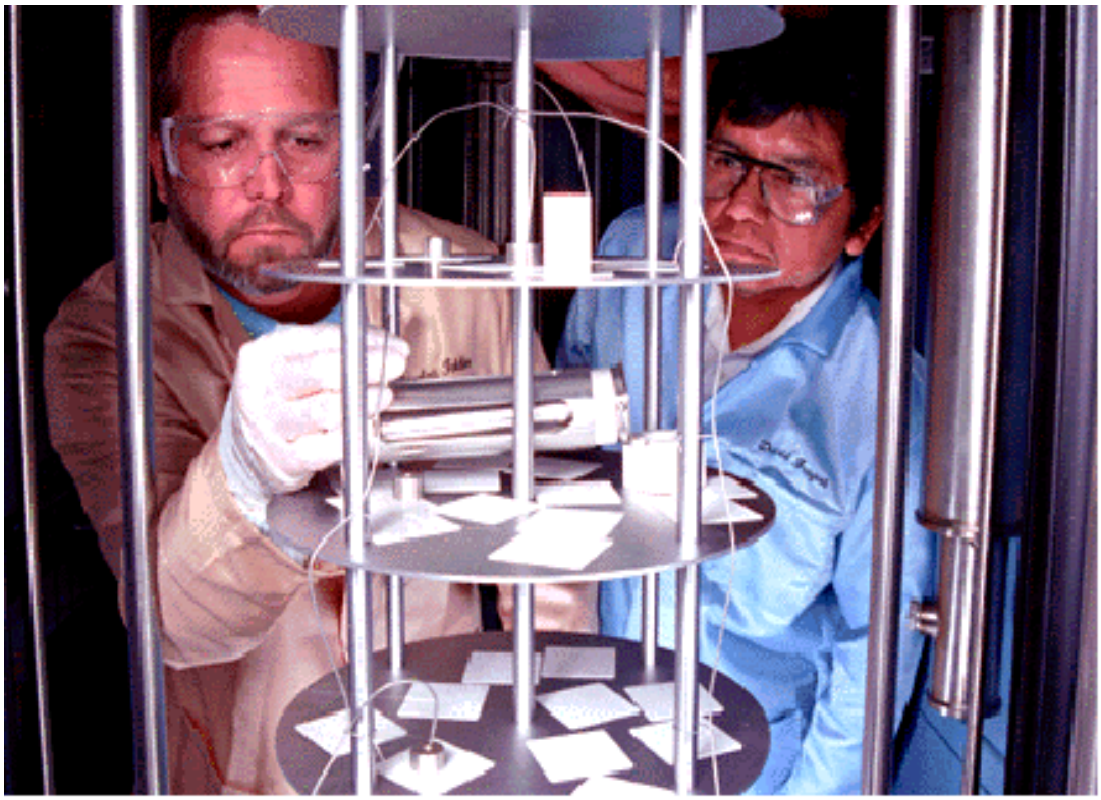
SANDIA AND GENERAL ELECTRIC PARTNERSHIP COMES FULL CIRCLE WITH HIGH-VOLTAGE VACUUM TUBE TECHNOLOGY

MORE THAN 40 YEARS OF COLLABORATION HONES R&D STRATEGIC ALLIANCE BETWEEN SANDIA AND GENERAL ELECTRIC

Seeking mutual research and development goals, Sandia joins forces again with General Electric to optimize scientific results that have both industry and defense applications. In a 2-year project, a multidisciplinary team of Sandia and GE researchers will seek to enhance design and testing capabilities in high voltage/high vacuum technologies. The longer term goal of capturing the history and development of the technology complements the shorter term goals of improved technologies and processes for both Sandia and GE production use.



Sandia assumed production responsibility for neutron tubes and neutron generators in the fall of 1993 after DOE's Pinellas (Fla.) plant closed. Sandia's recent agreement with GE will give Sandia an improved capability in the production of the neutron tube, a critical element in maintaining the nuclear stockpile. Here, Sandia researchers prepare neutron tube subassemblies for joining in a computer-controlled furnace at Sandia's Neutron Generator Facility.

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Sandia National Laboratories

Safety and health. Two primary considerations for living life fully. When you get an x-ray, you can be sure that your safety is being guarded in the diagnostic process and that the results will more clearly guide your health care choices. What you may not know is that the same technology that makes these medical diagnostics possible also supports U.S. military resources—whose mission also significantly affirms safety and health.

The high voltage/high vacuum technology that makes x-ray tubes possible has complementary application to the development of neutron tubes, a critical element in nuclear weapons. To enable the cutting edge research and development necessary for optimum application of the technology, Sandia has signed a cooperative research and development agreement (CRADA) with General Electric Corporation, a major manufacturer of x-ray tubes.

More than 1 million dollars of joint funds will support the partnership effort over a two year period. GE Corporate Research and Development (GE-CRD), located in Schenectady, NY, and GE Medical Systems (GEMS), located in Wisconsin, are teaming with Sandia researchers on three different projects.

GE AND SANDIA PARTNERSHIP GOES BACK TO THE 1950S

In the 1950s, scientists sought an optimum technology for the initiator of the nuclear detonation process. Two technologies—each with the capability of accelerating electrons to high energy—competed to provide the most workable solution. One of the technologies competing to provide the solution was a hefty 300-lb betatron, but scientists chose to go with the lighter weight 7-lb neutron generator. The neutoron generator is the technology still in use today.

As collaborators in developing and evaluating both technologies, Sandia and General Electric have collaborated on design and production issues supporting neutron generator manufacturing as far back as the early 1950's. GE had effective commercial manufacturing experience and research that complemented the national laboratories' expertise.

GE's world-renowned work with x-ray tubes continues to support Sandia's efforts to develop a critical element of the neutron generator, the neutron tube. From the 1950s to today, joint research and development by Sandia and GE continue to update and refine tube development.

CRADA Goals

The projects, each with distinct goals, are designed to enhance high voltage/high vacuum technology design and testing capabilities for both GE and Sandia. Sandia's neutron tube is similar to GE's x-ray computerized tomography (CT) tube in critical areas of development and technology—for example, both tubes operate in a similar range of high voltage. The tubes differ in some areas—for example, material deposition and profiles.

However, Sandia and GE researchers determined that they were facing enough critical development challenges that were common to both tubes. Benefits from this joint R&D will include test stand designs that both Sandia and GE will be able to use in design testing and analyses of their own tubes and processes. "The test

"This project bolsters our Defense Programs mission assignment in the design and development of War Reserve neutron tube technology." *Gary Laughlin—Sandia*

stand portion of the project will permit model validation, which is extremely important to gain confidence in the design," said Gary Laughlin, manager of Sandia's Neutron Tube Development Dept.

A high voltage insulator design and testing strategy that will optimize what is possible in current processes is also in the works. "As demands for higher power in constricted space increase," said GEMS's Jansen, "the limits of existing insulator designs are being exceeded. New approaches are needed to satisfy customer requirements."

A unique feature of this joint venture is seeking to capture research and scientific techniques and knowledge that heretofore have been the realm only of the original developer(s) of a process. Capturing the knowledge necessary to make the processes repeatable by others with predetermined results and parameters—i.e., standardized—is considered critical to effective updates and continuation of the technology. Generating a

report and designing software to investigate, evaluate, and document these processes is a joint initiative supported by both Sandia and GE.

Neutron Generator/Tube Capability at Sandia

As with car batteries, the ***neutron generator***—the critical initiator of the detonation process in nuclear weapons—needs to be replaced on a regular basis to ensure reliable functioning of the weapon. Thus, effective capabilities to produce the neutron generator continue to be paramount in ensuring readiness of the nuclear stockpile.

As a critical component of the neutron generator, the ***neutron tube,*** has been a *design* responsibility of Sandia scientists since the beginning of its use in weapon production (see side bar on front page). However,

"The expertise we [GE] found at Sandia, and the remarkable amount of overlap between the work done in neutron tubes and other areas at Sandia, and the X-ray tube work done at GEMS, give both sides a chance to learn and benefit from this relationship."
Floris Jansen—GE Medical Systems

with the closing of the Pinellas plant in Florida in 1993, Sandia also assumed the *production* responsibility for the whole *neutron generator*, including the neutron tube.

Working with GE has provided access for Sandia to commercial manufacturing expertise and experience that can be applied to update and refine the current neutron generator production process. The research and development results in this joint effort will also be applied to new neutron generator designs and processes.

GE's Computerized Tomography

Working with Sandia, GE seeks to update and refine its current CT technologies. GE's computerized tomography technologies, referred to as CT or CAT scans, markedly changed the effectiveness of x-ray

"We are moving to an ever-increasing model-based design approach, and this [partnership] gives us the opportunity to increase our understanding and confidence in our models."
Gary Laughlin—Sandia

diagnosis in the 1970s. Using CT, physicians can view very thin layers, or cross-sections, of the internal anatomy without surgery. To do this, CT technology joins x-ray imaging capability with computer processing capability. CT scans can be applied to a wide range of imaging requirements, including brain, spine, and abdomen. It can also used to determine the parameters of a trauma injury.

At the core of all x-ray and CT systems is the x-ray tube. Currently GE Medical Systems is considered the largest manufacturer of x-ray tubes, designing and manufacturing almost a quarter of the tubes in current use. GE comes by its expertise naturally, as a ground breaker in the early technology. In 1913, GE scientist Dr. William D. Coolidge was the first in the world to develop a hot-cathode, high vacuum x-ray tube.
—M. Minahan

DOE Defense Programs funded portions of Sandia's work for this project.